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SURFACE GEOLOGY OF BURLINGTON, IOWA.

BY CHARLES R. KEYES.

THE sedimentary rocks of Burlington have afforded such unrivaled facilities for the study of an extensive piscine and crinoidal fauna that attention has been almost totally diverted not only from other well represented faunal groups, but also the equally interesting stratigraphical and cenological features of that vicinity. While the palæontological researches were being so assiduously carried on, regional stratigraphy necessarily received, at divers times, more or less consideration, and is comparatively well understood. Recently a detailed investigation of the superficial deposits of the region was instituted, and a preliminary notice of the observations over a limited area is herewith presented.

The general geographical features of the annexed map have been compiled from Powers' map of the city of Burlington and a portion of the map of Des Moines county, as given in Andreas' Historical Atlas of Iowa. In a few minor particulars, observation has necessitated some corrections and additions. The hypsometrical features are approximately accurate—the contours (twenty feet apart) having been, for the most part, constructed from measured street and railway elevations, and, especially in the northern third of the area represented, from measurements personally made with level and rod. Over certain areas of limited extent estimates from points of prominence were also made. Along the eastern margins of North and Prospect hills the contours should in reality form a single line, but it has been deemed more advisable, for reasons hereafter stated, to deviate slightly from actuality, and project the individual contours distinctly.

The drift over the region cartographically represented in Plate XXIII, exhibits only the "Lower Till"—the southern boundary of the "Upper Till," or the till of the second glacial epoch, being considerably to the northwestward. Over this portion of the state the drift is usually more or less modified superficially. The boulders contained are for the most part comparatively few and of small size; they are seldom more than five or six feet in diameter, though a few miles from Burlington one is to be seen, the diametric measurement of which is more than fifteen feet. The preglacial surface expression of the region under consideration has manifestly not been completely obliterated by glaciation and the concomitant depositions, and the present topographic features are consequently in greater or less degree dependent upon the subjacent stratigraphic rocks which make up the greater portion of the altitude of the bluffs on either side of the Mississippi river at this point. The extreme attenuation of the till over the more elevated areas, and the deep accumulations of drift materials over the less elevated places, is evidenced by numerous exposures. In the valleys of Flint, Hawkeye and other smaller creeks, the depositions of the till attain a maximum thickness in some places of seventy or eighty feet.

The city of Burlington is built upon four "hills," all of which rise to a height of nearly two hundred feet above low water[1] in the Mississippi river at that place. Perhaps five-sixths of the altitude is formed of Burlington limestone and Kinderhook shales, which along the Mississippi river at Prospect and North hills, and also some parts bordering Flint creek, rise from the water's edge in high mural escarpments.

North of Hawkeye creek is a nearly insulated plateau, all sides of which are scalloped by steep-sided ravines, very deep toward the lower extremities, but interiorly becoming quickly lessened in depth, and the larger ones soon passing into small, broad, shallow drainage basins, which impart to the central portion of the plateau a characteristic, gently undulatory appearance. To the northeastward is a small subsidiary plain of subdued undulatory topography, evidently in no way dependent upon the underlying stratigraphic rocks. It rises thirty or more feet above the broad alluvial flood plain of the Mississippi river, and is divided by the Flint creek. Southwestward it passes rather abruptly into the comparatively gentle slopes of the general plateau. It manifestly occupies the preglacially corroded valley of Flint creek, and laterally rests upon the irregularly eroded slopes of the ancient water course. A section of this limited auxilliary plain exhibits the following structure: the exposure is continuous for nearly half a mile on Flint creek, and is practically similar throughout.

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[1] This is the basis of all elevations given in the accompanying map, and is assumed to be 510.77 feet above the sea-level. It was determined from a line of precise levels recently run by the Mississippi River Commission up the Mississippi river from the Gulf of Mexico, which gives the elevation of the U. S. P. B. M. 14, on the north end of the east abutment of the C. B. and Q. R. R. bridge over the Mississippi river at Burlington as 171.4352 meters.

SECTION I.[1]

1. Course, brown, friable loam, with occasional small pebbles, gradating imperceptibly into No. 2.............................. 3 feet.
2. Yellowish-brown clay of a characteristic fissured nature; containing a few small boulders or large pebbles, in places indistinctly laminated.. 15 feet.
3. Commingled sand and gravel irregularly stratified; pebbles up to six inches in diameter, mostly rounded, erratic, but with numerous local angular flint and limestone pieces............ 10 feet.
4. Drab, homogeneous unctuous clay........................ 2 feet.
5. Coarse yellow and white sand, with a few small, erratic pebbles, everywhere quaquaversally stratified..................... 6 feet.
6. Very fine homogeneous white sand (this is not present along the entire section)... 1 foot.
7. Coarse yellow and white sand, with rounded and striated erratic pebbles up to two feet in diameter, and larger local angular fragments of flint and fossiliferous (Burlington) limestone, exposed.. 12 feet.

One mile above on Flint creek the coarse yellow sands form a conspicuous feature. A short distance further north the lower till, with numerous small, rounded erratic boulders up to four feet in diameter, is well exposed in all its characteristic details. It is overlaid by six to eight feet of typical loess, containing numerous small lœsskindchen. The deposits here presented have an exposed thickness of sixty feet, and are seen to lean against the steep sides, the rather narrow gorge preglacially eroded by the waters of Flint creek to a depth of more than one hundred and thirty feet. North of Flint creek, and beyond the area represented in the annexed map, the topography in its general aspect is similar to that of the insulated plateau south. On the upper brow of the north slope of "North hill," a road cutting discloses the following arrangement:—

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[1] The several sections selected are regarded as the most typical of the numerous exposures examined, and are marked on the accompanying map.

SECTION II.

1. Brownish-yellow clay, free from gravel, and for the most part homogeneous; gradating into No. 2........................... 5 feet.

2. Typical ashen compact loess, containing numerous small loesskindchen and the following fossils:—

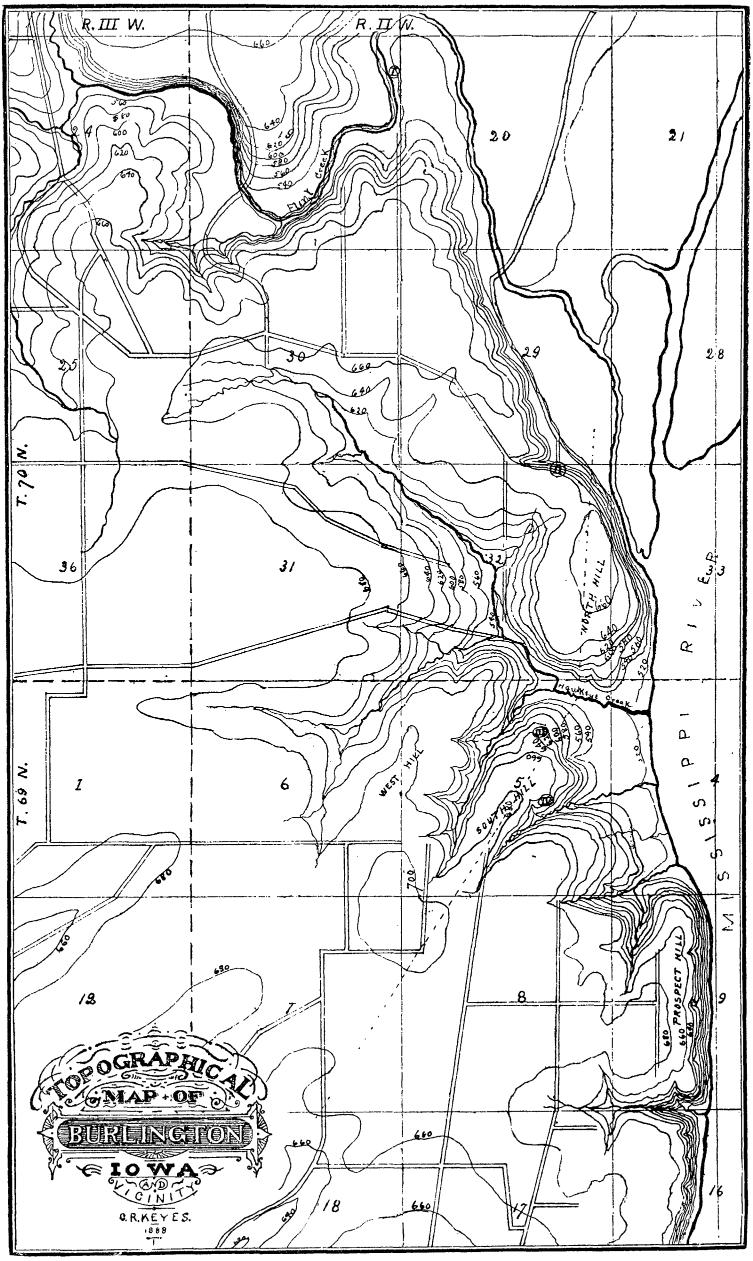
Pupa muscorum Linn.	*Succinea obliqua* Say.
Patula striatella Anth.	*Limnophysa desidiosa* Say.
Patula perspectiva Say.	*Helicina occulta* Say.......8 feet.

3. Till with an abundance of gravel, and pebbles up to three feet in diameter, exposed.. 20 feet.

Over the entire central portions of the northern plateau the distribution of quaternary deposits is essentially the same, except the lower member suffers a considerable attenuation over the more elevated parts, sometimes being reduced to a few feet in thickness. Upon removal of the drift materials glacial scorings and striæ on the subjacent palæozoic stratum have been disclosed in various places.

South of the Hawkeye creek rises a broad elevated plain so level in many places as to be almost devoid of natural drainage. Northeastward it is scalloped by short, deep ravines, but eastward it abruptly terminates with a perpendicular declivity, washed at its base by the Mississippi river, which has evidently separated the plateau from the highland of Henderson county, Illinois. To the southward and westward this level elevated plain gradually becomes gently undulatory and finally more broken by the small tributaries of Spring creek. Northwestward it merges into the general elevated

PLATE XXIII.



R. III W.
R. II W.
Flint Creek
20
21
28
29
30
25
T. 70 N.
36
31
32
NORTH HILL
MISSISSIPPI RIVER
E. W. R.
33
Hawkeye Creek
WEST HILL
SOUTH HILL
T. 69 N.
1
6
5
4
12
7
8
9
PROSPECT HILL
16
17
18
520
540
560
580
600
620
640
660
680
700
TOPOGRAPHICAL MAP OF BURLINGTON IOWA AND VICINITY
C. R. KEYES.
1888

plain occupying the greater portion of the county. Near the summit of "South Hill" section III. is exposed in a recently opened quarry:—

SECTION III.

1. Brownish clay, free from pebbles, becoming silty below, and gradating insensibly into No. 2.................................... 5 feet.
2. Compact ashen loess containing lösskindchen............. 9 feet.
3. Red tenacious clay, upper portion containing much gravel, the pebbles small, rounded, mainly erratic, a few local flint and limestone fragments disseminated throughout........................ 1 foot.
4. Large angular fragments of limestone and flint, the interstices filled with red clay.. 2 feet.
5. Upper Burlington limestone, exposed.................... 20 feet.

One quarter of a mile to the southeast, on the corner of south Fourth and Maple streets, a similar arrangement is shown, superimposing the *lower* Burlington limestone. The quaternary beds of the two places are manifestly continuous, but the elevation of the latter section is somewhat less than the former, and the deposits are all intensified; No. 1 of section III. having a thickness of six feet, No. 2 of 13 feet, and Nos. 3 and 4 together, of 6 feet. Southwestward from this exposure, perhaps one-fourth of a mile, a road cutting exhibits:—

1. Brownish-clay silty or loess-like below.................. 10 feet.
2. Typical lower till.. 25 feet.
3. Lower Burlington limestone, exposed.................. 5 feet.

Summarizing the observations herein briefly recorded, it is to be noted: (1) That the loess at Burlington, as in other portions of Iowa, occurs only over the elevated areas, and the fossils contained are all depauperate, evidencing, as pointed out by McGee and Call,[1] a much lower temperature of the air than at the present time, for it is also urged by those writers that the deposits of loess took place in ice-bound basins; (2) that the loess over the region under consideration has been by atmospheric agencies more or less modified superficially, often to a depth of five or six feet—the upper portion losing entirely its original character, but downward passing by insensible gradations into typical loess. This modification of the superior portion of the löss mantle is in many respects very similar to analogous changes superficially in the aspect of the residuary clays over certain parts of the driftless area lying in the northeastern portion of the state, and the contiguous parts of Illinois and Wisconsin —more specifically referred to by Chamberlain and Salisbury;[1] (3) that the stratigraphic rocks bordering the Mississippi river suffered considerable abrasion during the sojourn of the glacier, as is attested by numerous larger fragments of flint and limestone, which are manifestly not far removed from their origin, and also by the observed surfaces of striation over the elevated portions of the area cartographically represented by fig. 1; and (4) that the till which on the retreat of the glacier nearly, if not entirely, filled preglacially corraded channels has since been more or less completely removed from the numerous deep ravines occurring on all sides of the elevated plateaus of the region.

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[1] Am. Jour. Sci., Vol. XXIV., Sept., 1882.

ON THE INFLUENCE OF CIRCUMSTANCES ON THE ACTIONS AND HABITS OF ANIMALS, AND THAT OF THE ACTIONS AND HABITS OF LIVING BODIES, AS CAUSES WHICH MODIFY THEIR ORGANIZATION.

BY J. B. P. A. LAMARCK.[2]

(Continued from page 972.)

THAT which proves it, is that this is not true of the organ of hearing, which is always found in animals where the nature of their organization requires it. This is the reason. The material of sound, that which is moved by the shock or vibrations of bodies, transmits to the organ of hearing the impression which it has received from them, and penetrates everywhere, traversing all media, and even the masses of the most solid

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[1] U. S. Geol. Sur., Sixth Ann. Rep.

[2] Translated by Dr. E. E. Galt, from the edition of 1809.